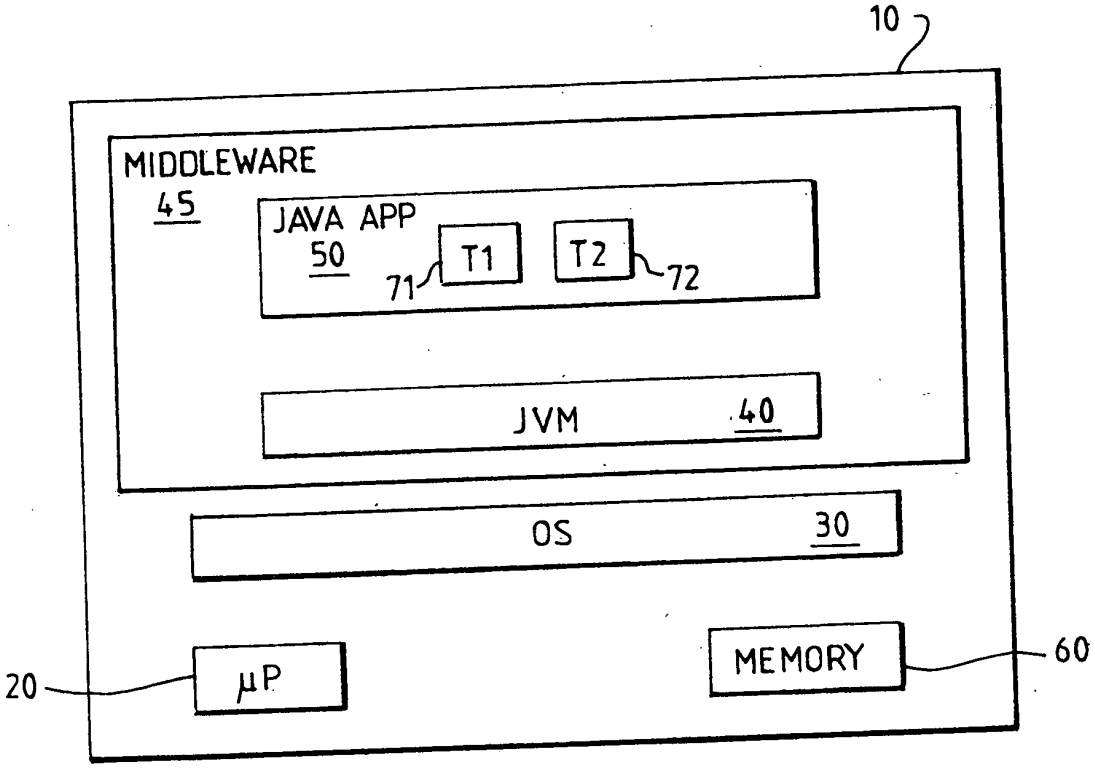
10
MIDDLEWARE
45
JAVA APP
50
T1
T2
71
72
JVM
40
OS
30
μP
20
MEMORY
60

FIG. 1

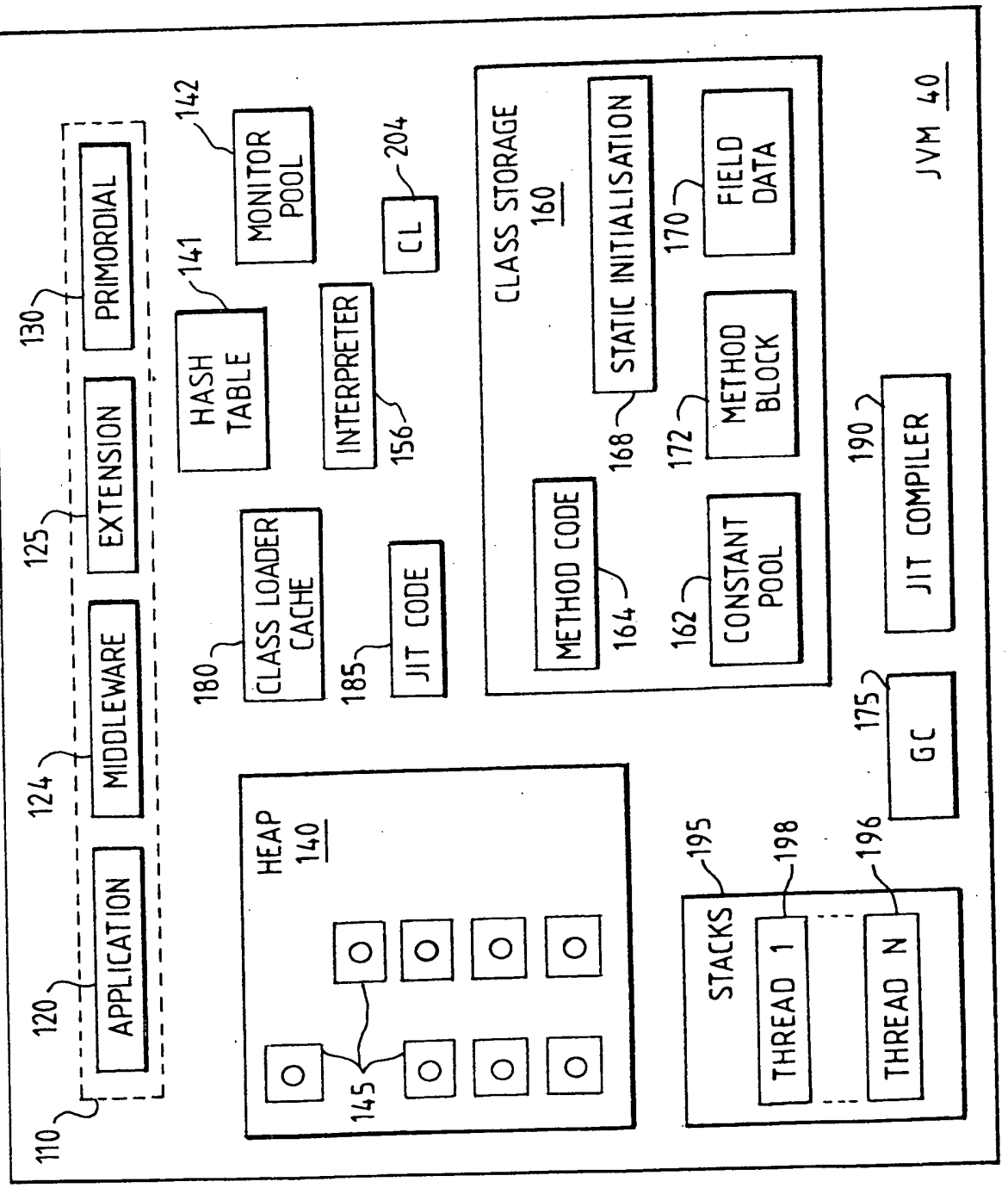
JVM 40
110
120
APPLICATION
124
MIDDLEWARE
125
EXTENSION
130
PRIMORDIAL
HEAP
140
145
180
CLASS LOADER CACHE
185
JIT CODE
HASH TABLE
141
142
MONITOR POOL
INTERPRETER
156
CL
204
CLASS STORAGE
160
METHOD CODE
164
168
STATIC INITIALISATION
170
FIELD DATA
162
CONSTANT POOL
172
METHOD BLOCK
190
JIT COMPILER
175
GC
STACKS
195
THREAD 1
198
THREAD N
196

FIG. 2

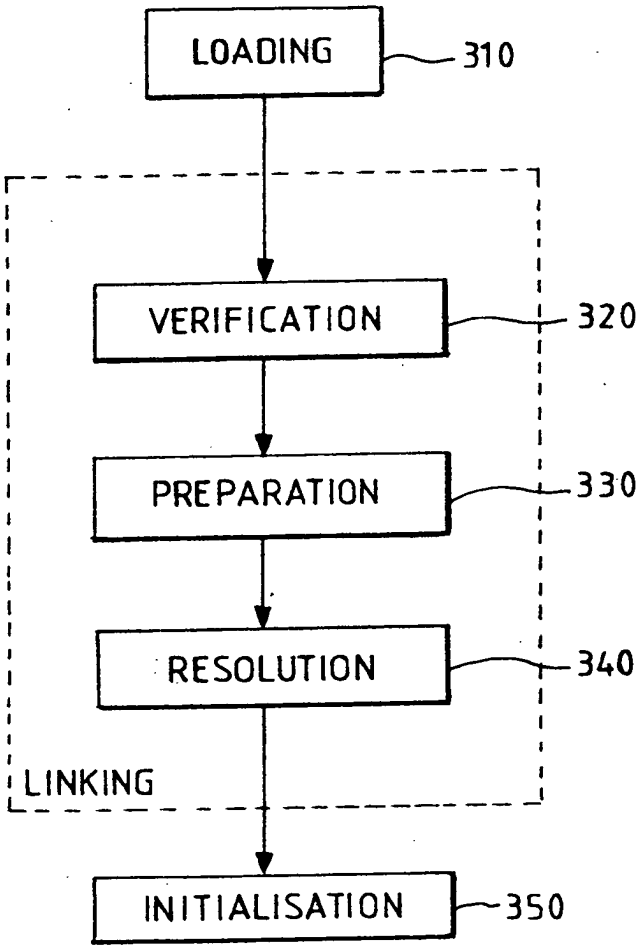

FIG. 3
PRIOR ART

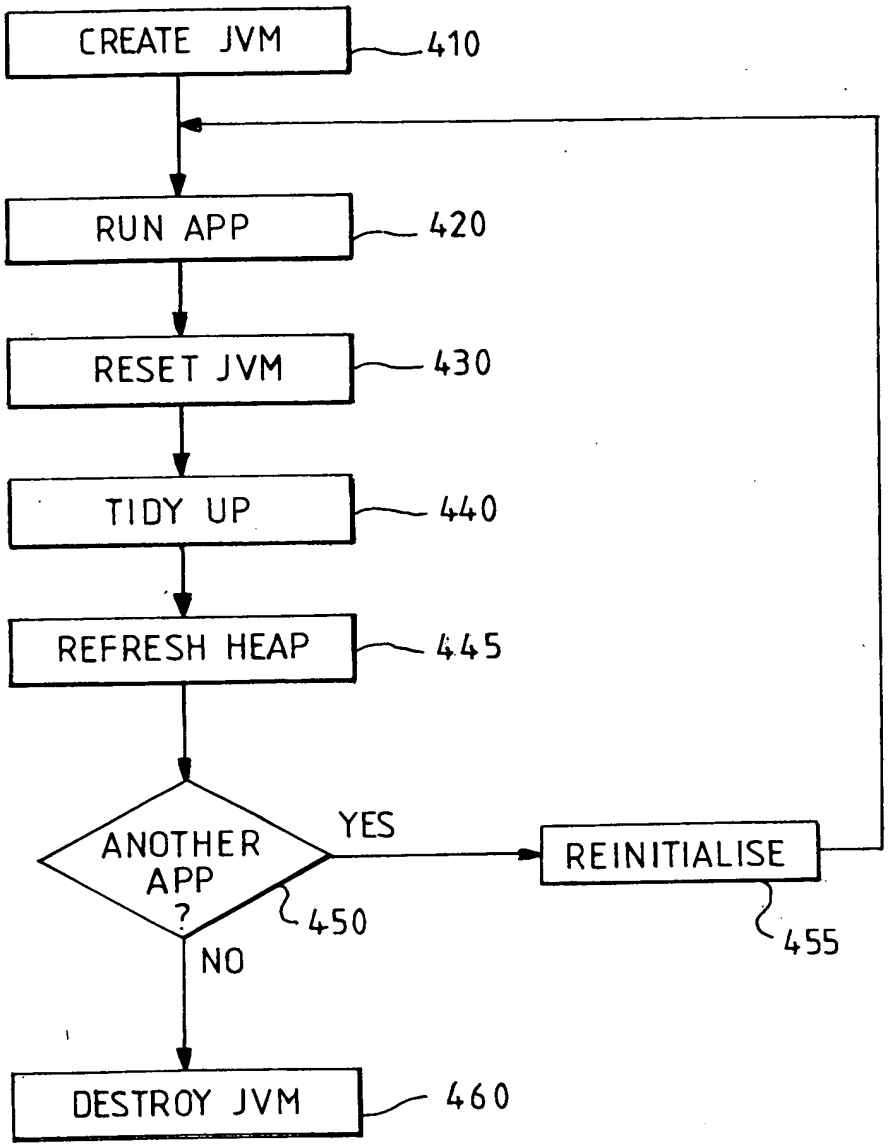
CREATE JVM
410
RUN APP
420
RESET JVM
430
TIDY UP
440
REFRESH HEAP
445
ANOTHER APP ?
YES
450
REINITIALISE
455
NO
DESTROY JVM
460

FIG. 4

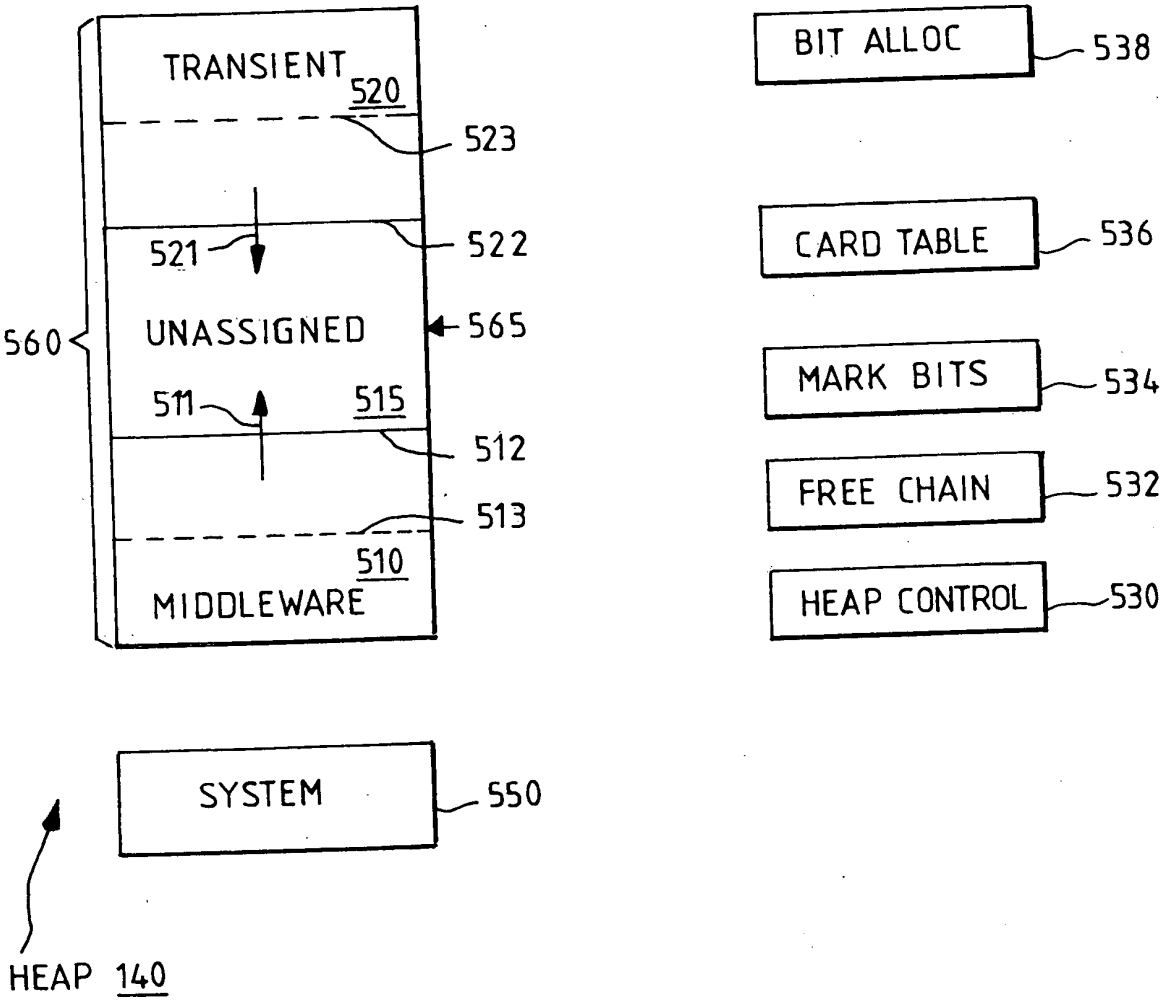
TRANSIENT
520
523
521
522
UNASSIGNED
560
565
511
515
512
513
510
MIDDLEWARE
SYSTEM
550
HEAP 140
BIT ALLOC
538
CARD TABLE
536
MARK BITS
534
FREE CHAIN
532
HEAP CONTROL
530

FIG. 5

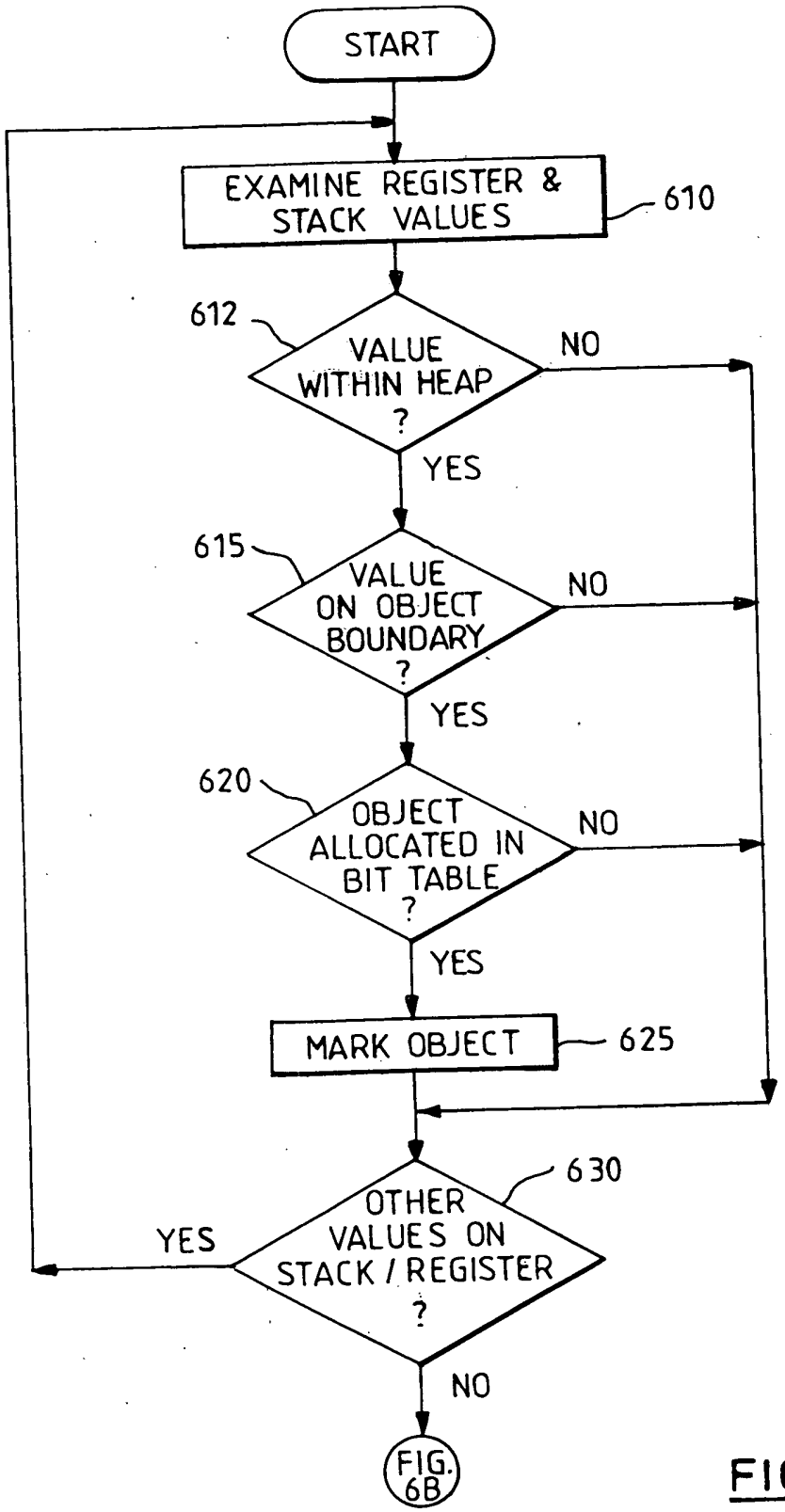
START
EXAMINE REGISTER & STACK VALUES
610
612
VALUE WITHIN HEAP ?
NO
YES
615
VALUE ON OBJECT BOUNDARY ?
NO
YES
620
OBJECT ALLOCATED IN BIT TABLE ?
NO
YES
MARK OBJECT
625
630
OTHER VALUES ON STACK / REGISTER ?
YES
NO
FIG. 6B

FIG. 6A

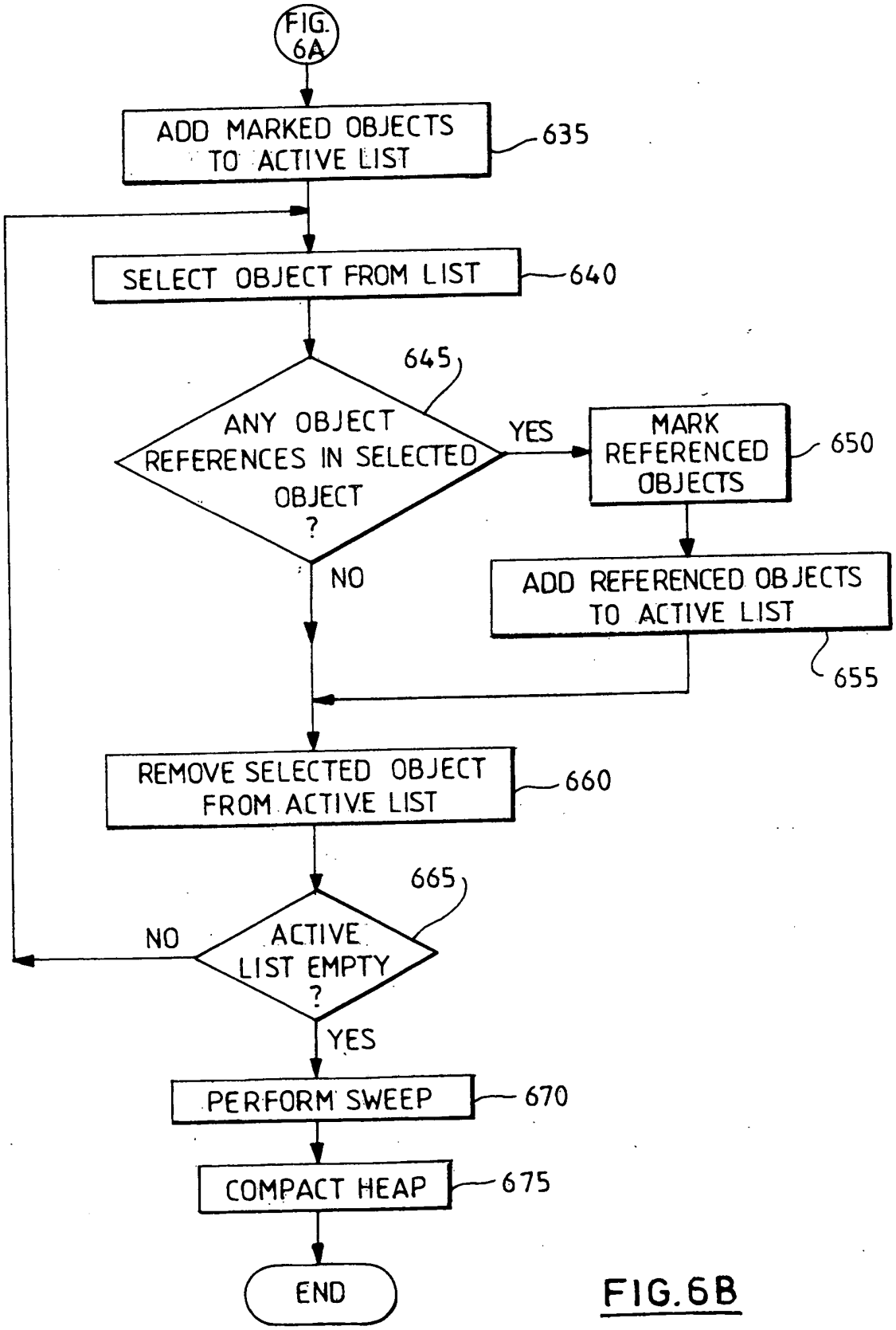
FIG. 6A
ADD MARKED OBJECTS TO ACTIVE LIST
635
SELECT OBJECT FROM LIST
640
645
ANY OBJECT REFERENCES IN SELECTED OBJECT ?
YES
MARK REFERENCED OBJECTS
650
NO
ADD REFERENCED OBJECTS TO ACTIVE LIST
655
REMOVE SELECTED OBJECT FROM ACTIVE LIST
660
665
NO
ACTIVE LIST EMPTY ?
YES
PERFORM SWEEP
670
COMPACT HEAP
675
END

FIG.6B

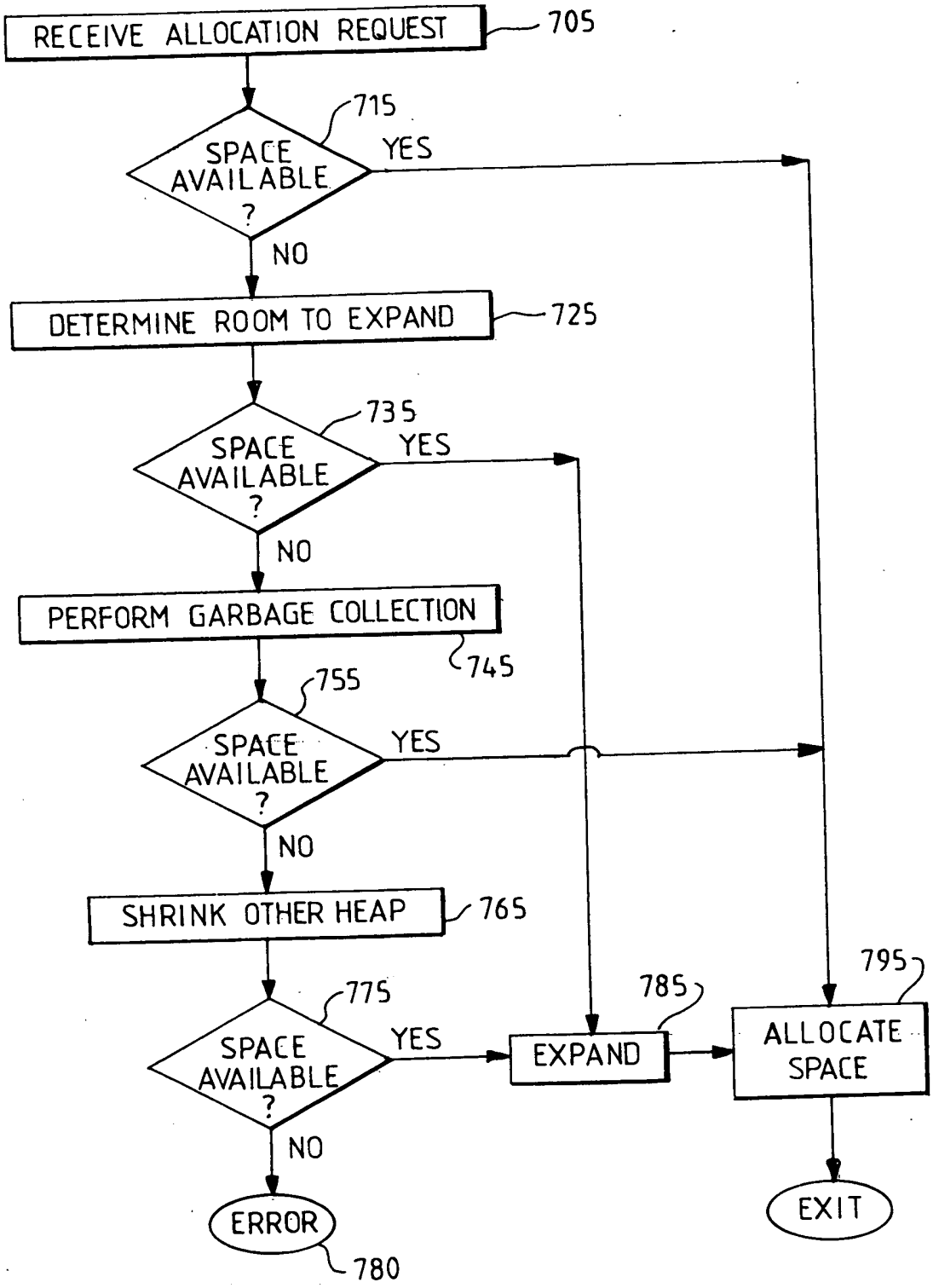
RECEIVE ALLOCATION REQUEST
705
SPACE AVAILABLE ?
715
YES
NO
DETERMINE ROOM TO EXPAND
725
SPACE AVAILABLE ?
735
YES
NO
PERFORM GARBAGE COLLECTION
745
SPACE AVAILABLE ?
755
YES
NO
SHRINK OTHER HEAP
765
SPACE AVAILABLE ?
775
YES
NO
ERROR
780
EXPAND
785
ALLOCATE SPACE
795
EXIT

FIG. 7

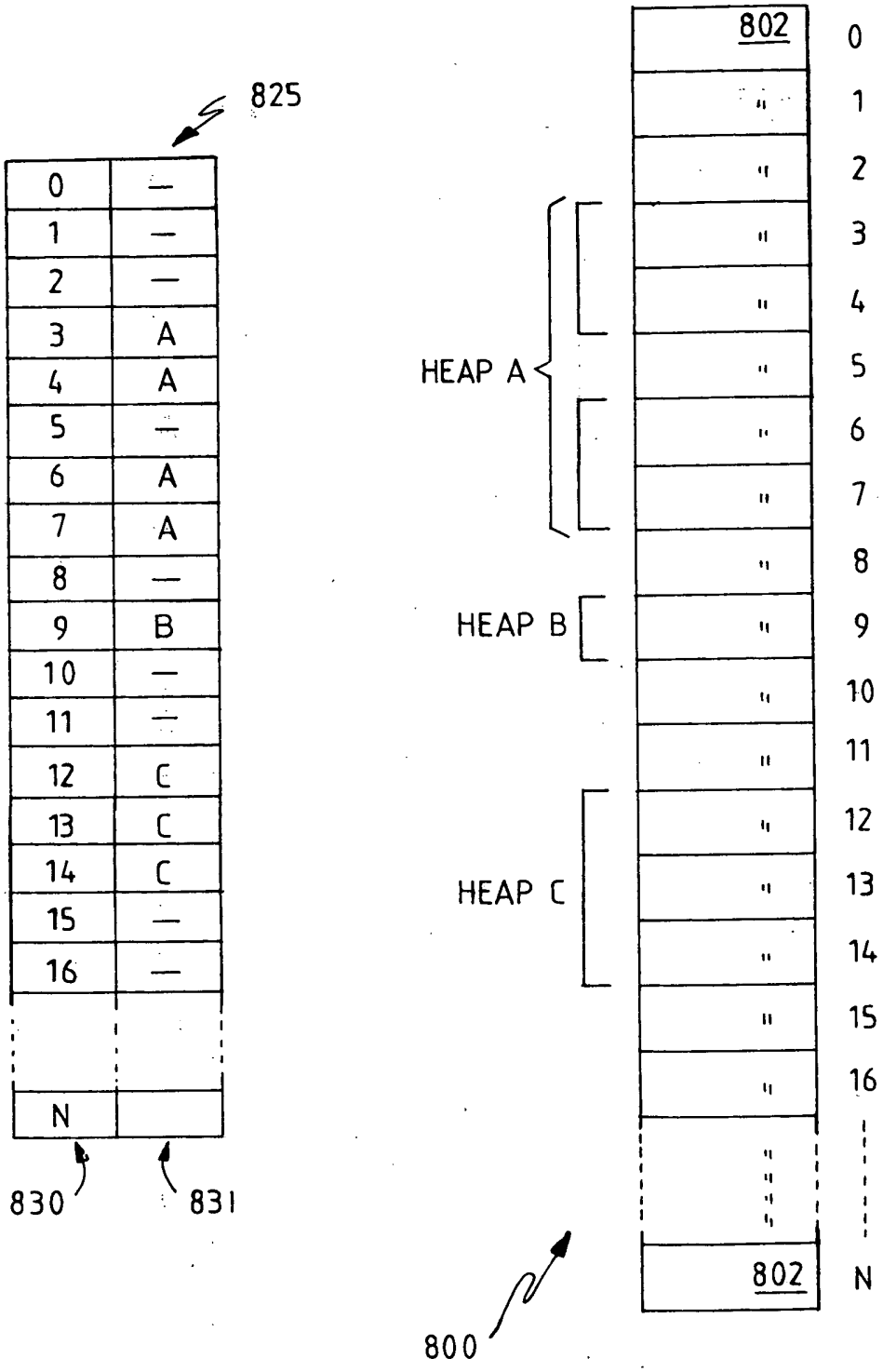
825
0 —
1 —
2 —
3 A
4 A
5 —
6 A
7 A
8 —
9 B
10 —
11 —
12 C
13 C
14 C
15 —
16 —
N
830
831
802
HEAP A
HEAP B
HEAP C
802
N
800

FIG. 8

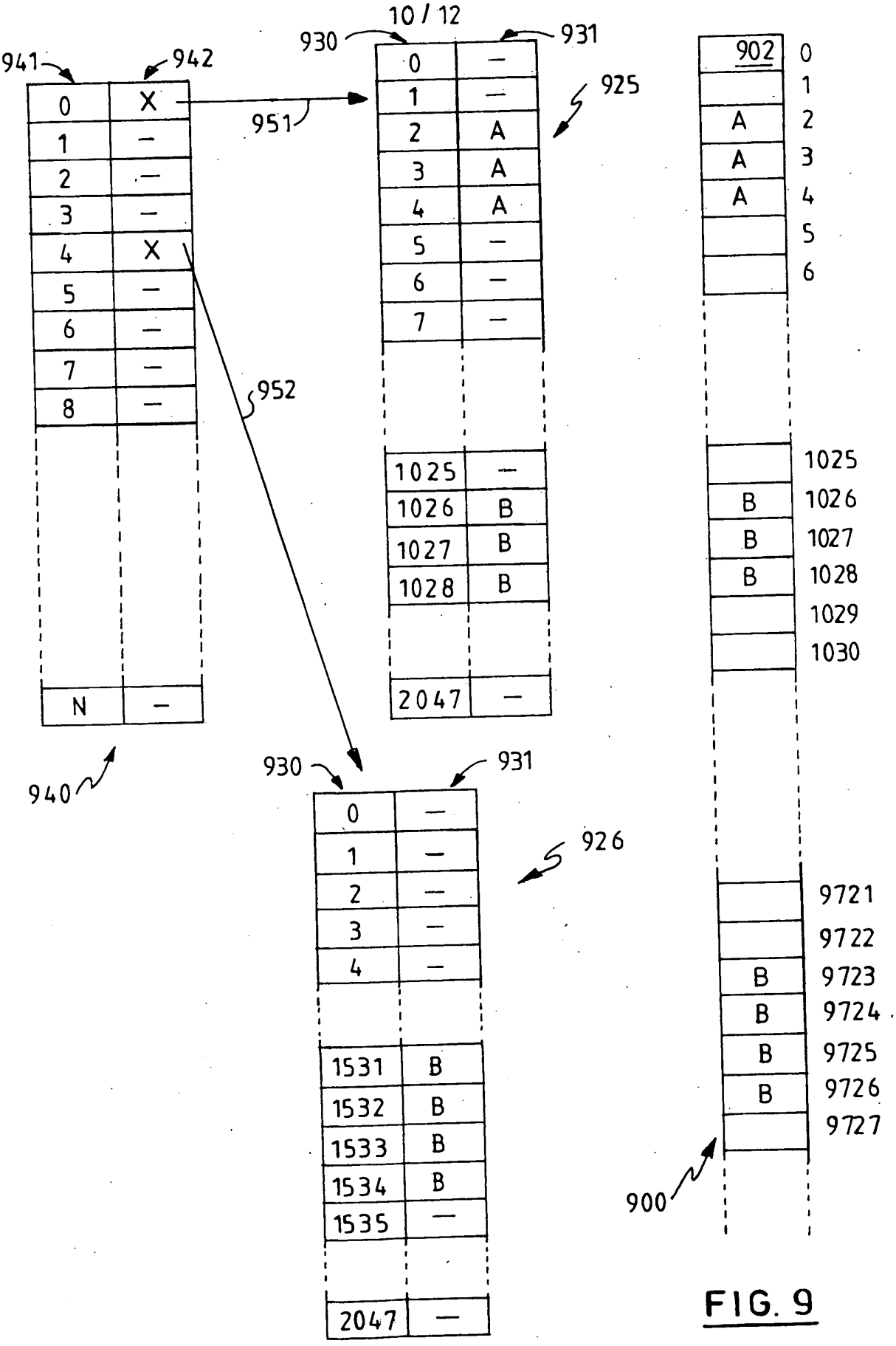
941
942
930
931
925
951
952
940
926
900
902
0 X
1 –
2 –
3 –
4 X
5 –
6 –
7 –
8 –
N –
0 –
1 –
2 A
3 A
4 A
5 –
6 –
7 –
1025 –
1026 B
1027 B
1028 B
2047 –
0 –
1 –
2 –
3 –
4 –
1531 B
1532 B
1533 B
1534 B
1535 –
2047 –
902 0
1
A 2
A 3
A 4
5
6
1025
B 1026
B 1027
B 1028
1029
1030
9721
9722
B 9723
B 9724
B 9725
B 9726
9727

FIG. 9

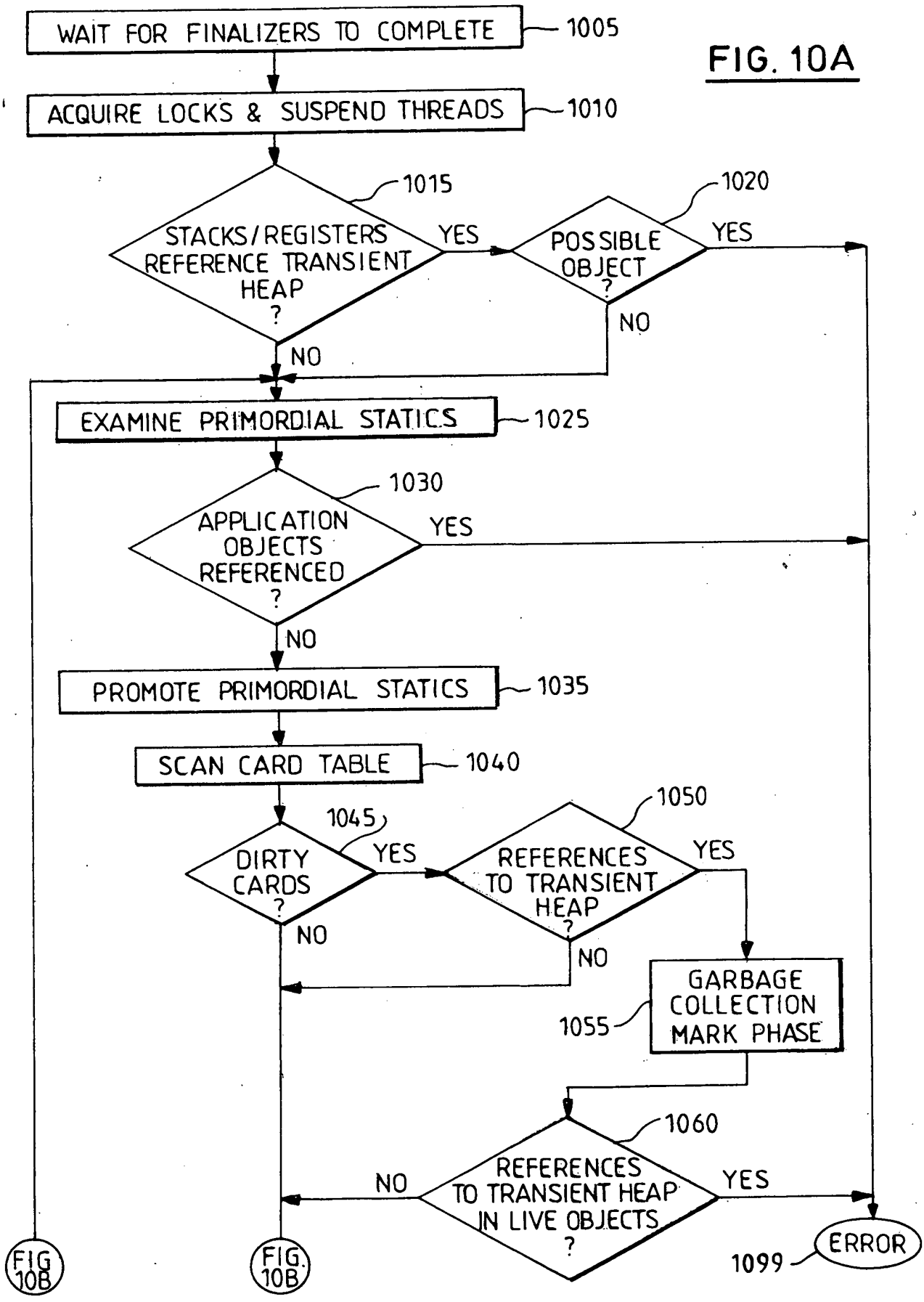
WAIT FOR FINALIZERS TO COMPLETE
1005
ACQUIRE LOCKS & SUSPEND THREADS
1010
1015
STACKS/REGISTERS REFERENCE TRANSIENT HEAP ?
YES
1020
POSSIBLE OBJECT ?
YES
NO
NO
EXAMINE PRIMORDIAL STATICS
1025
1030
APPLICATION OBJECTS REFERENCED ?
YES
NO
PROMOTE PRIMORDIAL STATICS
1035
SCAN CARD TABLE
1040
1045
DIRTY CARDS ?
YES
1050
REFERENCES TO TRANSIENT HEAP ?
YES
NO
NO
GARBAGE COLLECTION MARK PHASE
1055
1060
REFERENCES TO TRANSIENT HEAP IN LIVE OBJECTS ?
NO
YES
ERROR
1099
FIG 10B
FIG 10B

FIG. 10A

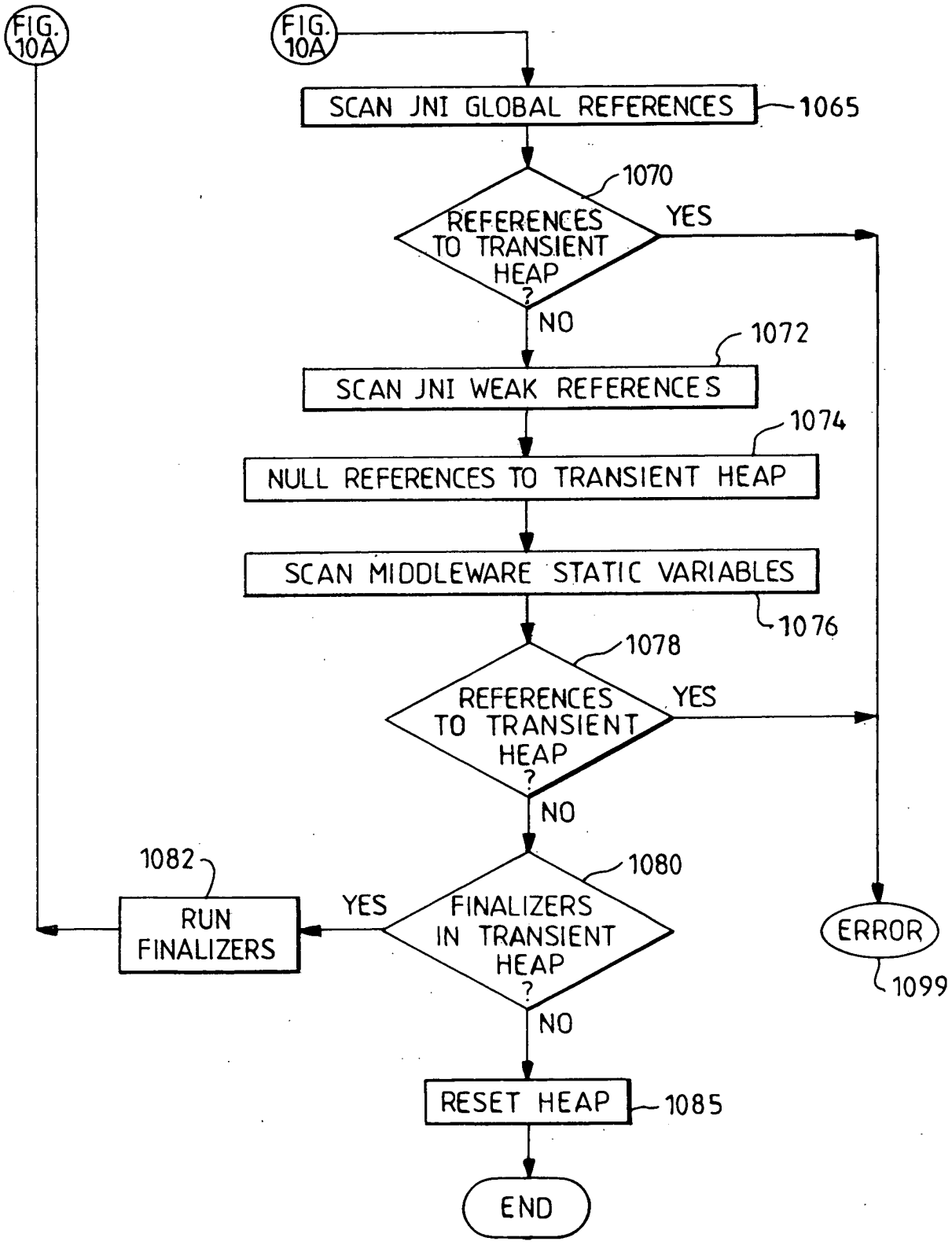
FIG. 10A
FIG. 10A
SCAN JNI GLOBAL REFERENCES
1065
1070
REFERENCES TO TRANSIENT HEAP ?
YES
NO
1072
SCAN JNI WEAK REFERENCES
1074
NULL REFERENCES TO TRANSIENT HEAP
SCAN MIDDLEWARE STATIC VARIABLES
1076
1078
REFERENCES TO TRANSIENT HEAP ?
YES
NO
1082
1080
RUN FINALIZERS
YES
FINALIZERS IN TRANSIENT HEAP ?
ERROR
1099
NO
RESET HEAP
1085
END

FIG. 10B